143-TYPE AMPLIFIERS
TESTS, ADJUSTMENTS AND REQUIREMENTS

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1. GENERAL

1.01 This section covers the tests and requirements that apply to amplifiers coded 143A, 143B, and 143C. Information is included which will be of help in clearing cases of trouble.

1.02 This issue reorganizes the section to simplify testing procedures and to include information on recent production changes. Since a general revision has been made, arrows ordinarily used to indicate changes have been omitted.

1.03 In amplifiers made after October 20, 1956 changes were made in the high voltage filter arrangement. Two schematic diagrams are now provided in this section. Figs. 7 and 8 show the circuits used before and after the changes were made.

1.04 Section 024-107-300 lists the initial and routine tests which are to be made on the 143-type amplifiers. The circuit description and parts lists are contained in Section 024-107-100. Input circuit variations are covered in Section 024-107-101.

1.05 *Test Equipment:* The tests throughout this section require the use of the following test equipment:

1 — KS-14510 Volt-Ohm-Milliammeter or Weston 779A Analyzer
1 — KS-15560 Tube Tester
1 — 19C Oscillator or equivalent
1 — 13A, 21A, or 30A Transmission Measuring Set
1 — 5A Attenuator
1 — Output Pad as described in Paragraph 2.10
1 — 600-Ohm Resistor, 106A or ½-watt carbon
3 — W3U Shielded Cords or equivalent

1.06 Tests should be made in the order listed.

2. TESTS AND ADJUSTMENTS

(A) Primary Power Voltage Measurement and Adjustment

2.01 The purpose of this test is to determine which connections on the power transformer T2 are to be connected to the ac supply terminals. In the current model of the 143-type amplifier, T2 is a KS-14254 transformer, on which the winding taps are brought out to terminal lugs. Connections to amplifier terminals 21 and 22 are made by means of straps. In earlier models of the 143-type amplifier, T2 is a KS-13820 transformer on which the winding taps are brought out as flexible leads. In this case the proper flexible leads are terminated directly on terminals 21 and 22.

2.02 *Apparatus:*

KS-14510 Volt-Ohm-Milliammeter or Weston 779A Analyzer

2.03 *Procedure:*

(1) Adjust the voltmeter to a range suitable for an ac reading of over 100 volts.

(2) Measure the supply voltage at the fuse box or other convenient point between the fuse box and the amplifier.

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Required Strapping: The correct taps on the primary winding of the power transformer are determined as follows:

AC Voltage	Taps on T2	
	Terminals on KS-14254	Leads on KS-13820
105-115	1 and 2	Black and Black-Yellow
115-125	1 and 3	Black and Black-Red

2.04 If the power line connections are made to taps 1 and 2 of transformer T2 (105-115-volt range), and the office power line supply voltage is consistently higher (disregarding occasional momentary peaks or surges) the electron tube life will be reduced. If transformer T2 taps 1 and 3 are used (115-125-volt range), and the office voltage is consistently lower (disregarding occasional dips) the power handling capacity of the amplifier may be affected, causing overloading.

(B) Electron Tube Tests

2.05 These tests will check the tubes for correct operation in the amplifier.

2.06 *Apparatus:*

KS-15560 Tube Tester

2.07 *Procedure:*

(1) Test each tube in accordance with information given in Section 100-635-101.

(2) Discard any tubes which fail to meet the requirements.

Warning: It is advisable, for safety and electrical reasons, to switch off the power to the amplifier before removing any tubes. This applies particularly to the rectifier tube V11. The control grid bias voltage for the output stage tubes (V4 to V7, inclusive) is supplied from V11. Removal of the latter while the amplifier is switched on will damage the output stage tubes and other circuit components due to operation without bias.

(C) Gain and Gain-Frequency Tests

2.08 Gain tests on 143-type amplifiers require great care due not only to high gains which may be encountered but also to the fact that these amplifiers are capable of much greater power output than those usually encountered in the telephone plant. The use of shielded conductors is specified. This should aid materially in avoiding errors due to stray coupling between input and output circuits when measuring high gains. In all cases, an attenuator *with sufficient maximum loss* should be employed between the source of the testing power and the amplifier. A pad between the output of the amplifier and the transmission measuring set is also specified in order that the power handling capacity of the latter will not be exceeded. Gain is measured with the amplifier furnishing power at a level 10 db below its maximum power rating.

2.09 In all cases the output level of the oscillator should be adjusted to 1 milliwatt at each of the test frequencies specified in Table 1 on Page ..... The oscillator and transmission measuring set should be connected together, and the oscillator adjusted until a reading of 0 dbm is obtained on the measuring set. Then the connections to the oscillator and measuring set should be rearranged for each test as specified. If adjustment of oscillator output is required to obtain a reading of 0 dbm at any test frequency, the same output level should be used when the amplifier is tested.

2.10 Fig. 1 shows a suggested arrangement of the output pad referred to in Paragraph 2.08. This arrangement utilizes values of resistors which should not be difficult to obtain locally. The loss of this pad will be approximately 38.8 db when connected between the amplifier output and a 600-ohm transmission measuring set. Resistors used in constructing the pad should be individually selected so as to be within ± 1.0% of the values shown. In the case of the 162-ohm and 7.5-ohm resistors it may be necessary to obtain adjustable units of higher value and set them for the value shown, using a precision resistance bridge. A W. E. Co. type 106A resistor can be obtained in the 600-ohm value. Resistor values have been chosen so that when gain tests are made about 1 milliwatt of power (0 dbm) will be delivered to the transmission measuring set. When the maximum power output capability of the amplifier is tested the transmission measuring set will receive about 10 milliwatts of power (+10 dbm).

Caution: When connecting the output pad to the amplifier use copper wire of 20 gauge or heavier. Test cords having tinsel conductors must not be used for this purpose.

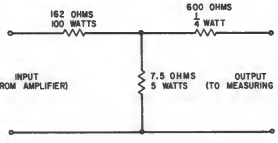


Fig. 1 — Suggested Output Pad Arrangement

2.11 The following equipment is required for making these tests:

19C Oscillator or equivalent
5A Attenuator
Output Pad as described in Paragraph 2.10
13A, 21A, or 30A Transmission Measuring Set
W3U Shielded Cords or equivalent

2.12 *Procedure:* Set up the testing arrangements indicated in Fig. 2 or 3, using the input terminals for the particular input arrangement of the amplifier under test. Strap the amplifier to work into a nominal load of 170 ohms. (See schematic.) Fig. 2 shows the shielding and grounding employed in the arrangement for gain test on the 143A amplifier. Fig. 3 shows the arrangement for testing the B and C models. Somewhat more shielding and grounding is employed in Fig. 3 because of the higher gains in these amplifiers, particularly in the 143B model. Make the tests on the amplifier in the order listed in Table 1 on page 8. The gain of the amplifier is indicated by the algebraic sum of the attenuator loss, output pad loss, and the dial and meter reading on the measuring set. For example, if the 1000-cycle gain of a 143B amplifier is to be measured, set up the equipment as shown in Fig. 3 and in Table 1 on page 8. Assuming that the transmission measuring set indicates a received level of +1.0 dbm the amplifier gain would be computed this way:

5A Attenuator loss	77 db
Output Pad loss	38.8 db
Transmission Set reading	+1.0 dbm
Total gain (G_B)	116.8 db

Requirement: The amplifier gain must be within the minimum and maximum limits specified in Table 1 on page 8.

2.13 The amplifier is next tested to determine if it is capable of delivering its maximum rated output power. This test disregards the actual amplifier gain at full output.

Caution: The amplifier should not be required to furnish energy consisting of continuous tone at its maximum rated power for longer than 30 minutes.

2.14 *Procedure:* With the equipment set up as indicated in Paragraph 2.12 for the measurement of 1000-cycle gain (G_A, G_B, or G_C) adjust the transmission measuring set to receive a level of +10 dbm. Decrease the loss of the 5A attenuator in steps of 1 db until the required amplifier output is obtained or until the amplifier output stops increasing with increases in input. As maximum output power is approached the

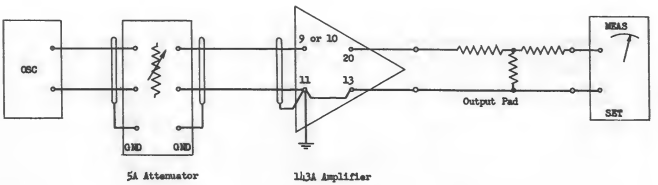


Fig. 2 — 143A Amplifier — Gain and Gain-Frequency Testing Arrangement

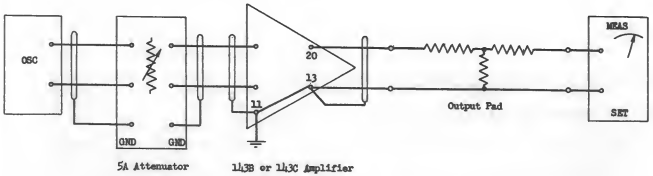


Fig. 3 — 143B and 143C Amplifier — Gain and Gain-Frequency Testing Arrangement

output will not change db for db with changes in the input signal. This is due to compression, a small amount of which is normal in the 143-type amplifier. The output power expressed in dbm is the sum of the output pad loss and the reading of the transmission measuring set. For example, when making this test on a 50-watt amplifier and using a 38.8 db pad, the attenuator loss should be reduced until the measuring set reads at least +8.2 dbm since:

Required output	=	+47.0 dbm
Subtract Pad loss of		+38.8 db
Required Measuring Set Reading	=	+ 8.2 dbm

Requirement: The maximum output power shall be not less than +48.8 dbm for amplifiers arranged for 75 watts or +47.0 dbm for amplifiers arranged for 50 watts output.

2.15 Some kinds of trouble in the amplifier circuit can cause peak clipping as the amplifier is driven to full output. This may not become evident when the above tests are made unless the output waveform is viewed on an oscilloscope. This is recommended if an oscilloscope is available.

(D) Noise Tests

2.16 The purpose of this test is to determine whether or not the ratio of maximum single-frequency signal to steady noise is adequate for the amplifier arrangement involved.

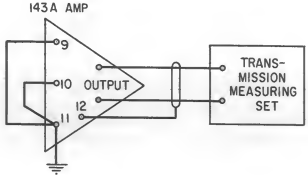


Fig. 4

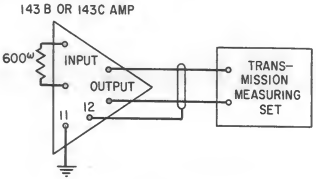


Fig. 5

2.17 *Apparatus:*

13A, 21A, or 30A Transmission Measuring Set
600-Ohm Resistor with short leads

2.18 *Procedure:*

(1) Energize the amplifier and set all gain controls to minimum.

(2) Adjust the measuring set to read levels up to +10 dbm.

(3) Set up the testing arrangement shown in Fig. 4 for testing the 143A or Fig. 5 for testing the 143B or C.

(4) Advance the amplifier gain controls to maximum. If a steady reading of +10 dbm or higher is noted while advancing the gain control, reduce the gain control to minimum and inspect the test setup for improper connections and inadequate ground or shielding.

(5) With the amplifier gain controls at maximum read the steady noise level on the measuring set.

Requirement: The noise limit indicated in Table 2 should not be exceeded; these figures apply to either the 50-watt or 75-watt arrangement.

Table 2

Noise Requirements on 143-Type Amplifiers

Amplifier (See Note 1)	Input Terminal Arrangements	Gain Control P1 on 143-Type Ampl	Gain Control on 141A Preamplifier	Maximum Permissible Noise
143A	Short and ground terminals 9, 10, and 11	Max	—	−30 dbm
143B	Connect 600 ohms to terminals 1 and 3 and ground terminal 11	Max	70 db	0 dbm
143B	Same	Max	40 db	−25 dbm
143C	Connect 600 ohms to terminals 4 and 8 and ground terminal 11; strap terminals 6 and 7	Max	—	−30 dbm

Note 1: Use 170-ohm output connection. (Terminals 13 and 20. Strap terminals 14 and 15, 16 and 17, 18 and 19.)

(E) Preliminary Trouble Locating Tests

2.19 When the amplifier is in trouble and the cause is not due to defective tubes, the amplifier should be checked (with ac power switched off) for loose connections, or broken wires.

2.20 If the amplifier can be turned on without being damaged (such as by arcing or overheating) then there is one simple test which will help to locate the area of trouble. With the amplifier set up as described in Paragraph 2.12, set the gain control (P1) to minimum and remove the output pad, connecting the transmission measuring set directly to the output terminals. Advance the amplifier gain control so as to supply about 1 milliwatt of 1000-cycle power (0 dbm) to the transmission set. When this has been done, bridge the input side of the output pad across the amplifier output terminals. If this change from a light load condition (600^{m}) to a full load condition causes the transmission set reading to drop more than 2.5 db, then the trouble condition is somewhere within the "feed-back loop." That is to say that it is in the circuitry associated with stages V_2, V_3, V_4, V_5, V_6, or V_7.

2.21 Figs. 10 and 11 are wiring diagrams of the basic or 143A amplifier, and Fig. 12 is a wiring diagram of the input circuit of the 143B amplifier. This is actually a diagram of the 141A amplifier. Fig. 6 is a block diagram of the 143C amplifier.

(F) Operating Voltage Measurements

2.22 If the tests mentioned above fail to reveal the trouble, it will be necessary to check the operating voltages in the amplifier. Figs. 7, 8, and 9 show these voltages in the basic amplifier and 141A preamplifier. Fig. 7 shows the circuit used in production of the basic amplifier prior to October 20, 1956. Fig. 8 shows the circuit used after that date. The changes involved the arrangement of the electrolytic filter capacitors. The values shown are typical of those which may be expected when employing a voltmeter with a resistance of at least 20,000 ohms per volt (KS-14510), and an ac line voltage of 120 volts.

2.23 The voltages on the various elements of the electron tubes may be measured at the sockets on the underside of the chassis. The terminal on the socket to which each element of the

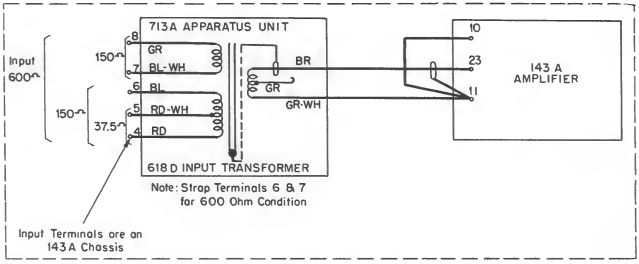


Fig. 6 — 143C Amplifier — Block Diagram

electron tube is connected is indicated by terminal number on the schematic drawings in Figs. 7, 8, and 9. The standard numbering sequence for the tube sockets is shown on the wiring diagrams in Figs. 10 and 12.

2.24 Where the 143-type amplifier under test is an early production model employing a KS-13820 power transformer, Table 3 will be of aid by showing the relationship between the leads of this transformer and the terminals on T2 of Fig. 7 or 8.

Table 3

Terminals on KS-14254 (T2)	Lead Colors on KS-13820
1	Black
2	Black-Yellow
3	Black-Red
4	Brown
5	Brown
6	Red
7	Orange
8	Red-Yellow
9	Orange
10	Red
11	Yellow
12	Yellow
13	Green
14	Green-Yellow
15	Green

2.25 During operation of the amplifier the control grid bias voltage for the output stage tubes (V4 to V7, inclusive) may become too low if the cathode emission of V11 is reduced. This may occur after the amplifier has been in service for some time and will be manifested by reduction in amplifier output level, distortion of output signal and excessive heating of circuit elements including the output stage tubes V4 to V7, the output transformer T1 and the power transformer T2. Accordingly, in lieu of periodic replacement of tube V11, it is suggested that the voltages in the output stage be measured periodically to check this possibility, and that V11 be replaced if the successive readings indicate progressive departure from earlier readings, particularly if the readings depart more than 20% from the nominal values given in Figs. 7 and 8.

2.26 *Apparatus:*

KS-14510 Volt-Ohm-Milliammeter

2.27 *Procedure:*

(1) Switch on the ac power supply and allow several minutes for warm up.

(2) Obtain voltage readings, beginning at the output of the power rectifier tube and working back through the circuit to the elements of the other tubes until an indication of the trouble location is obtained. Voltages shown in parenthesis on the schematic diagram refer to the 50-watt arrangement.

Warning: In making these tests, care should be taken to avoid contact with live terminals. It should be noted that normal operating voltages of over 400 volts may be encountered.

(G) Electrolytic Capacitor Testing and Replacement

2.28 It may be necessary to attempt to re-form the film in the electrolytic capacitors in a 143-type amplifier if the latter has not been in use for several months. In such a case the film, which is the dielectric, tends to deteriorate progressively. If polarized capacitors are connected to dc power of proper voltage for sufficient time, the film can usually be restored, provided the deterioration has not progressed too far. This may be done following the method described in Section 032-110-701. A simple re-forming process consists of one-half hour or more of application of dc voltage by switching on the amplifier.

2.29 If the hum level of the amplifier is high after an attempt has been made to re-form the capacitor film, the capacitors should be tested as described in Section 032-110-701, and replaced where the need is indicated.

Table 1

Gain and Gain-Frequency Characteristics

Of 143-Type Amplifiers

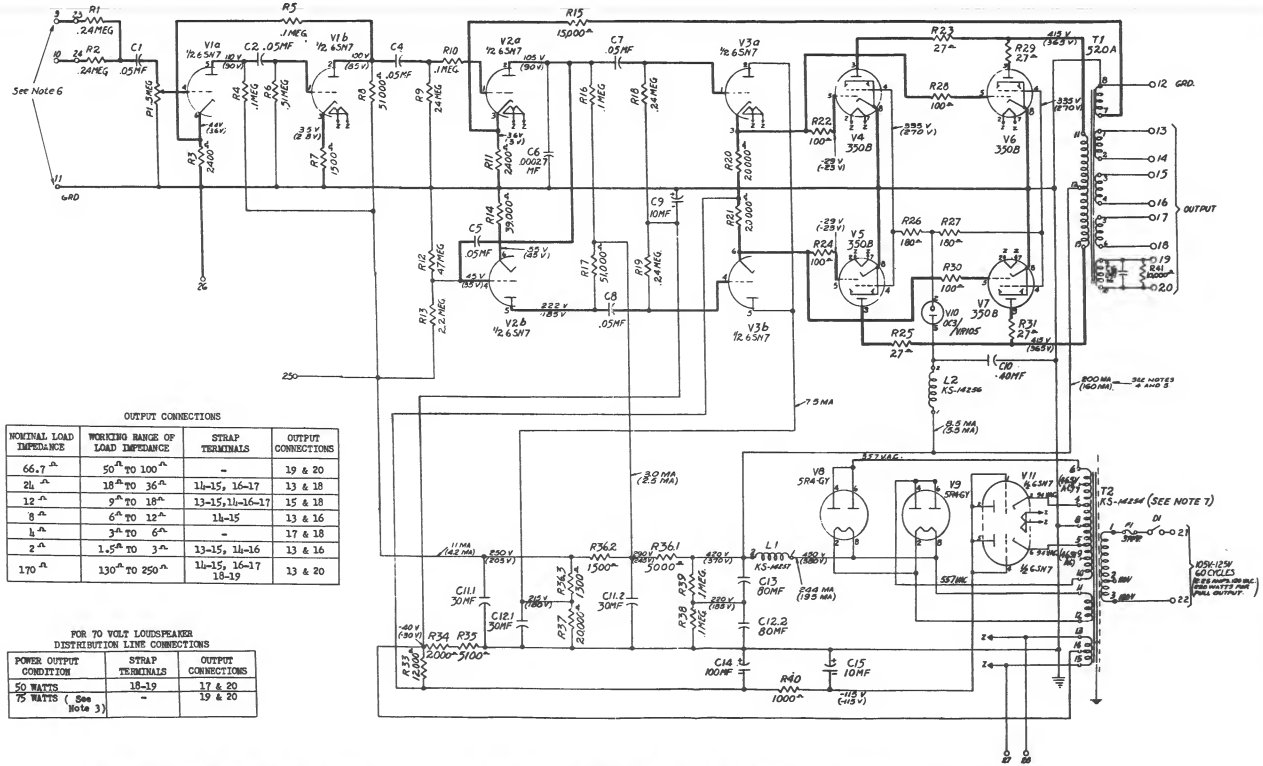
Amplifiers and Test Frequencies (See Note 1)	Input Terminal Connections	Loss of 5A Attenuator (See Note 2)	Strap Terminals	141A Preamp Gain	Required Gain (See Notes 3 and 4)	
					Minimum	Maximum
143A						
1000	9-11	13 db	10-11	—	$(G_A) = 50.5$	53.5
1000	10-11	13 db	9-11	—	$(G_A) = 50.5$	53.5
50	10-11	13 db	9-11	—	$G_A - 1.0$ db	$G_A + 0$
15,000	10-11	13 db	9-11	—	$G_A - 0.8$ db	$G_A + 0.8$ db
143B						
1000	1-3	77 db	—	70 db	$(G_B) = 115$ db	119 db
1000	1-3	67 db	—	60 db	$(G_B - 10) - 2$ db	$(G_B - 10) + 2$ db
1000	1-3	57 db	—	50 db	$(G_B - 20) - 2.5$ db	$(G_B - 20) + 2.5$ db
1000	1-3	47 db	—	40 db	$(G_B - 30) - 3$ db	$(G_B - 30) + 3$ db
50	1-3	77 db	—	70 db	$G_B - 1.5$ db	$G_B + 0.5$ db
15,000	1-3	77 db	—	70 db	$G_B - 1.5$ db	$G_B + 1.5$ db
143C						
1000	4-8	32 db	6-7	—	$(G_C) = 69.5$	72.5
50	4-8	32 db	6-7	—	$G_C - 2.0$ db	$G_C + 1$ db
10,000	4-8	32 db	6-7	—	$G_C - 1.0$ db	$G_C + 2$ db

Note 1: Use 170-ohm output connections. (Terminals 13 and 20. Strap terminals 14 to 15, 16 to 17, 18 to 19.)

Note 2: Gain control P1 on 143A amplifier should be at maximum.

Note 3: The gain requirement is shown for the 75-watt condition; if the amplifier is arranged for 50-watt operation the gain requirement is 1.8 db less.

Note 4: G_A is the measured 1000-cycle gain of a 143A amplifier.
G_B is the measured 1000-cycle gain of a 143B amplifier.
G_C is the measured 1000-cycle gain of a 143C amplifier.



OUTPUT CONNECTIONS

NOMINAL LOAD IMPEDANCE	WORKING RANGE OF LOAD IMPEDANCE	STRAP TERMINALS	OUTPUT CONNECTIONS
66.7 Ω	50 Ω TO 100 Ω	-	19 & 20
24 Ω	18 Ω TO 36 Ω	14-15, 16-17	13 & 18
12 Ω	9 Ω TO 18 Ω	13-15, 14-16-17	15 & 18
8 Ω	6 Ω TO 12 Ω	14-15	13 & 16
4 Ω	3 Ω TO 6 Ω	-	17 & 18
2 Ω	1.5 Ω TO 3 Ω	13-15, 14-16	13 & 16
170 Ω	130 Ω TO 250 Ω	14-15, 16-17 18-19	13 & 20

FOR 70 VOLT LOUDSPEAKER DISTRIBUTION LINE CONNECTIONS

POWER OUTPUT CONDITION	STRAP TERMINALS	OUTPUT CONNECTIONS
50 WATTS	18-19	17 & 20
75 WATTS (See Note 3)	-	19 & 20

NOTE 1: CIRCUIT SHOWN CONNECTED FOR USE WITH 350B TUBES. (75 WATTS POWER OUTPUT)

NOTE 2: TO USE 6L6 TUBES (50 WATTS POWER OUTPUT) THE FOLLOWING CHANGES ARE NECESSARY:

(A) SHORT CIRCUIT R34.

(B) ON TRANSFORMER T2 TRANSFER LEAD ON TERMINAL 6 TO TERMINAL 7 AND LEAD ON TERMINAL 10 TO TERMINAL 9.

NOTE 3: RATED 75 WATTS FOR SPEECH AND MUSIC ONLY.

NOTE 4: THE VOLTAGES AND CURRENTS SHOWN REPRESENT TYPICAL VALUES FOR A QUIESCENT CONDITION WITH AVERAGE TUBES AND OPERATED FROM 60 ~ 120 VOLT POWER SOURCE. THE D-C VOLTAGES SHOULD BE MEASURED WITH A VOLTMETER OF 20,000 OHMS PER VOLT. VOLTAGES ARE MEASURED FROM POINTS SHOWN TO TERMINAL 26 AND SHOULD BE WITHIN ± 20%.

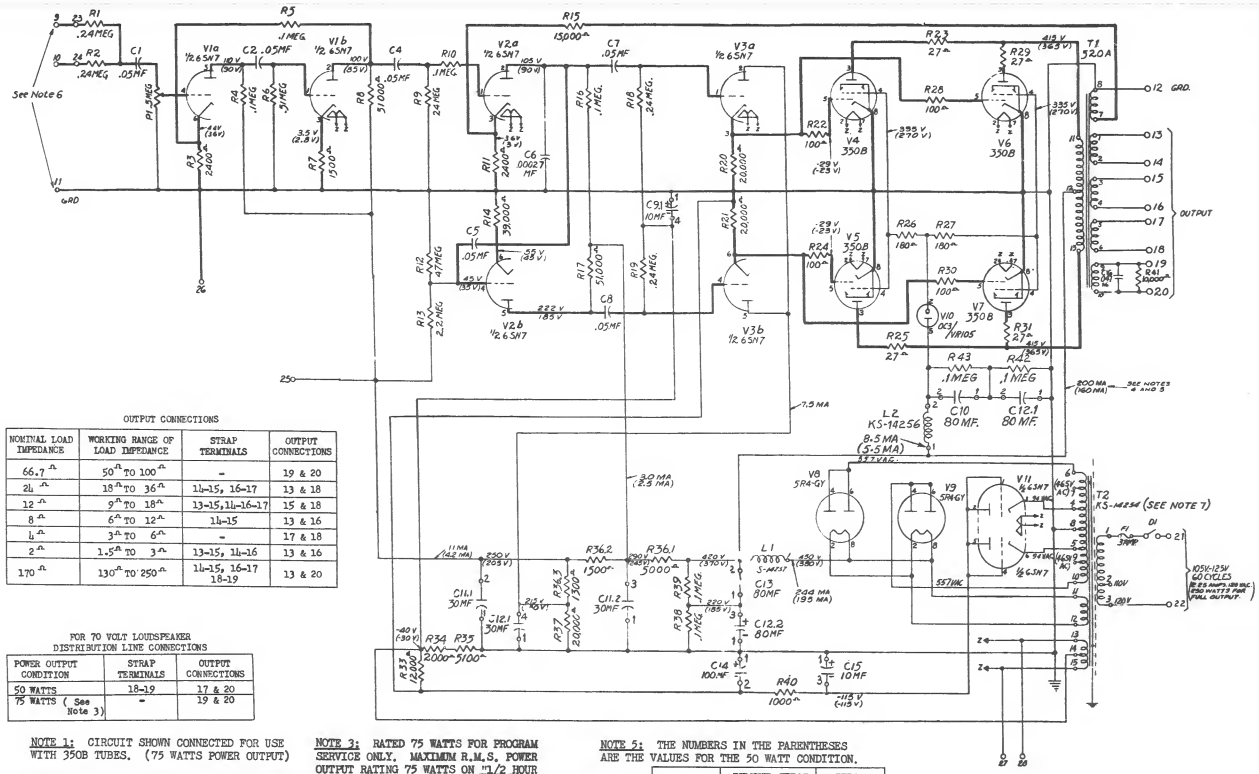
NOTE 5: THE NUMBERS IN THE PARENTHESES ARE THE VALUES FOR THE 50 WATT CONDITION.

NOTE 6:

AMPLIFIER	REMOVE STRAP BETWEEN TERM.	STRAP TERMINALS
143B	9-23	10 TO 11
143C	9-23	10 TO 11

NOTE 7: REFER TO TEXT WHEN T2 IS KS-13820.

Fig. 7 — 143A Amplifier — Early Production



OUTPUT CONNECTIONS

NOMINAL LOAD IMPEDANCE	WORKING RANGE OF LOAD IMPEDANCE	STRAP TERMINALS	OUTPUT CONNECTIONS
66.7 Ω	50Ω TO 100Ω	-	19 & 20
24 Ω	18Ω TO 36Ω	14-15, 16-17	13 & 18
12 Ω	9Ω TO 18Ω	13-15, 14-16-17	15 & 18
8 Ω	6Ω TO 12Ω	14-15	13 & 16
4 Ω	3Ω TO 6Ω	-	17 & 18
2 Ω	1.5Ω TO 3Ω	13-15, 14-16	13 & 16
170 Ω	130Ω TO 250Ω	14-15, 16-17 18-19	13 & 20

FOR 70 VOLT LOUDSPEAKER DISTRIBUTION LINE CONNECTIONS

POWER OUTPUT CONDITION	STRAP TERMINALS	OUTPUT CONNECTIONS
50 WATTS	18-19	17 & 20
75 WATTS (See Note 3)	-	19 & 20

NOTE 1: CIRCUIT SHOWN CONNECTED FOR USE WITH 350B TUBES. (75 WATTS POWER OUTPUT)

NOTE 2: TO USE 6L6 TUBES (50 WATTS POWER OUTPUT) THE FOLLOWING CHANGES ARE NECESSARY:

(A) SHORT CIRCUIT R34.

(B) ON TRANSFORMER T2 TRANSFER LEAD ON TERMINAL 6 TO TERMINAL 7 AND LEAD ON TERMINAL 10 TO TERMINAL 9

NOTE 3: RATED 75 WATTS FOR PROGRAM SERVICE ONLY. MAXIMUM R.M.S. POWER OUTPUT RATING 75 WATTS ON "1/2 HOUR ON, 1-1/2 HOURS OFF BASIS."

NOTE 4: THE VOLTAGES AND CURRENTS SHOWN REPRESENT TYPICAL VALUES FOR A QUIESCENT CONDITION WITH AVERAGE TUBES AND OPERATED FROM 60~ 120 VOLT POWER SOURCE. THE D.C. VOLTAGES SHOULD BE MEASURED WITH A VOLTMETER OF 11 MEGOHM D.C. RESISTANCE. VOLTAGES ARE MEASURED FROM POINTS SHOWN TO TERMINAL 26 AND SHOULD BE WITHIN ± 20%.

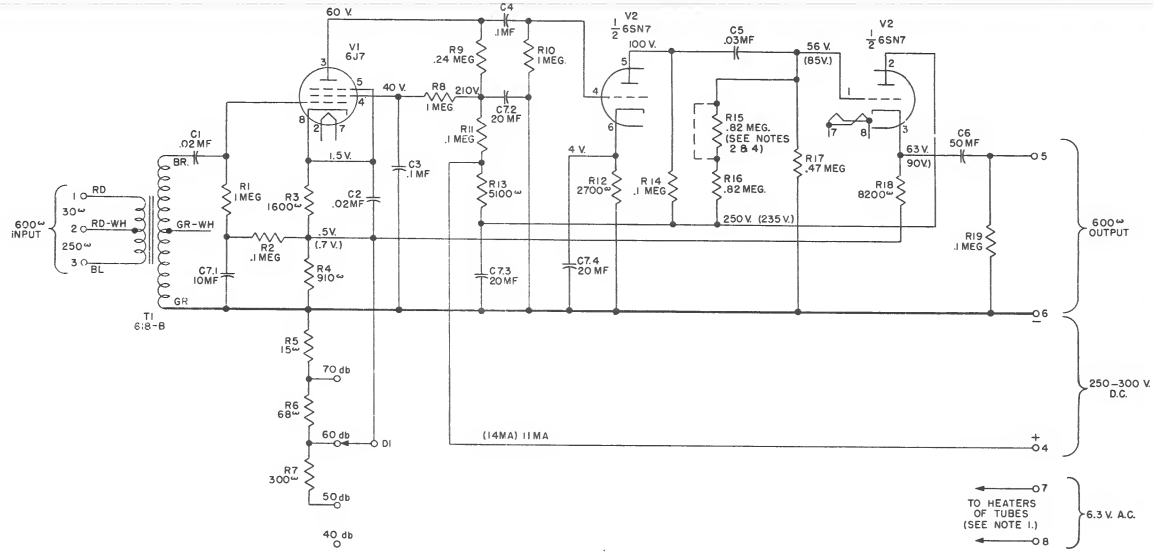
NOTE 5: THE NUMBERS IN THE PARENTHESES ARE THE VALUES FOR THE 50 WATT CONDITION.

NOTE 6:

AMPLIFIER	REMOVE STRAP BETWEEN TERM.	STRAP TERMINALS
143B	9-23	10 TO 11
143C	9-23	10 TO 11

NOTE 7: REFER TO TEXT WHEN T2 IS KS-13820.

Fig. 8 — 143A Amplifier — Production after 10/20/56



NOTES:

1. FOR MINIMUM NOISE LEVEL, THE HEATER SUPPLY SHOULD BE BIASED ±5 TO ±45 VOLTS D.C. WITH RESPECT TO GROUND.

2. THE OUTPUT POWER VARIES WITH THE GAIN SETTING AND LOAD IMPEDANCE AND IS TABULATED BELOW FOR REPRESENTATIVE OPERATING CONDITIONS. THESE OUTPUT LEVELS ARE OBTAINED WITH NOT MORE THAN 1% TOTAL HARMONIC DISTORTION OVER THE FREQUENCY RANGE OF 50 TO 7500 CYCLES WHEN A 300 VOLT D.C. SUPPLY IS EMPLOYED.

GAIN CONTROL POSITION	CIRCUIT AS SUPPLIED	R15 SHORTED
	600 OHM LOAD	
40	+11	+14
50	+11	+14
60	+10	+13
70	+6	+11
	6000 OHM LOAD	
40	+17	+17
50	+17	+17
60	+17	+16
70	+15	+15

3. THE NUMBERS IN PARENTHESES ARE THE VOLTAGES AND CURRENT WITH R15 SHORTED.

4. IN CASES WHEN THE "B" SUPPLY VOLTAGE IS OTHER THAN 300 V., THE VOLTAGES INDICATED ARE MULTIPLIED BY THE RATIO OF THAT VOLTAGE TO 300.

5. THE VOLTAGES AND TOTAL CURRENT INDICATED REPRESENTS TYPICAL OPERATING CONDITIONS WITH AVERAGE TUBES, WITH A 300 V. D.C. "B" SUPPLY AND THE GAIN CONTROL AT 70 db. THESE VOLTAGES SHOULD BE MEASURED WITH A VOLTMETER HAVING 11 MEGOHMS D.C. RESISTANCE. VOLTAGES ARE MEASURED FROM POINTS SHOWN TO TERMINAL 6 AND SHOULD BE WITHIN ±20%.

Fig. 9 — 143B Amplifier — Input Circuit Arrangement (141A Amplifier Schematic)

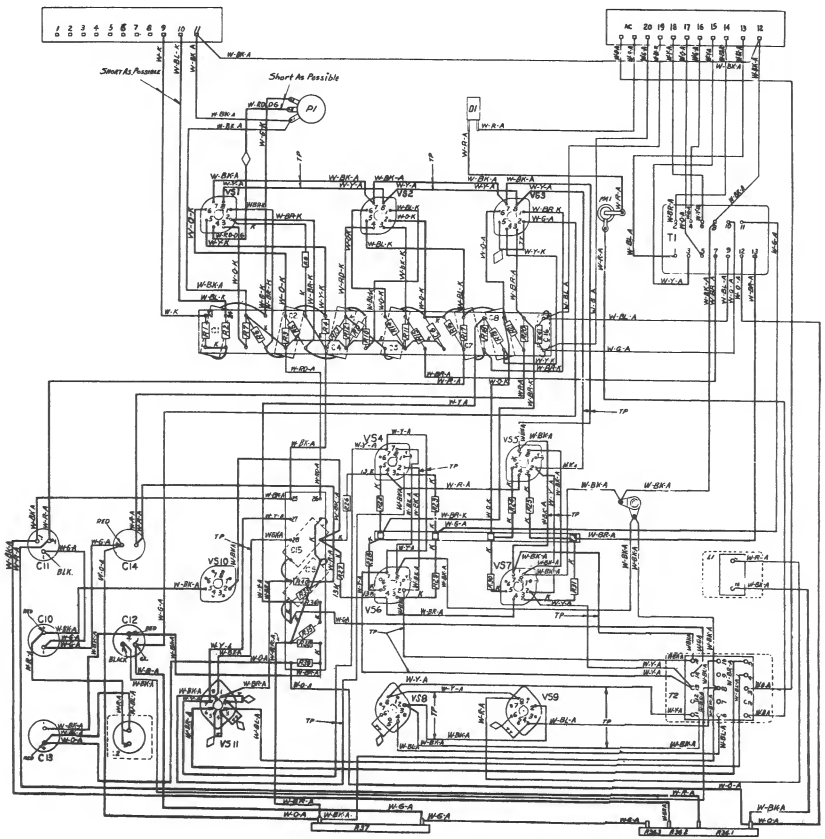


Fig. 10 — 143A Amplifier — Early Production

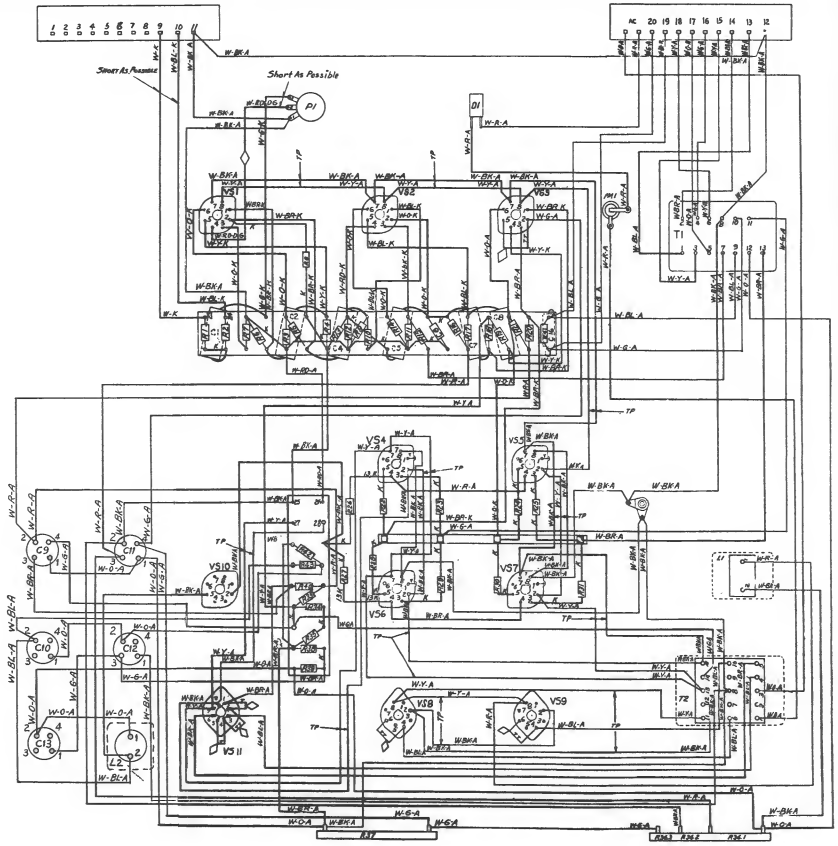


Fig. 11 — 143A Amplifier — Production After 10/20/56

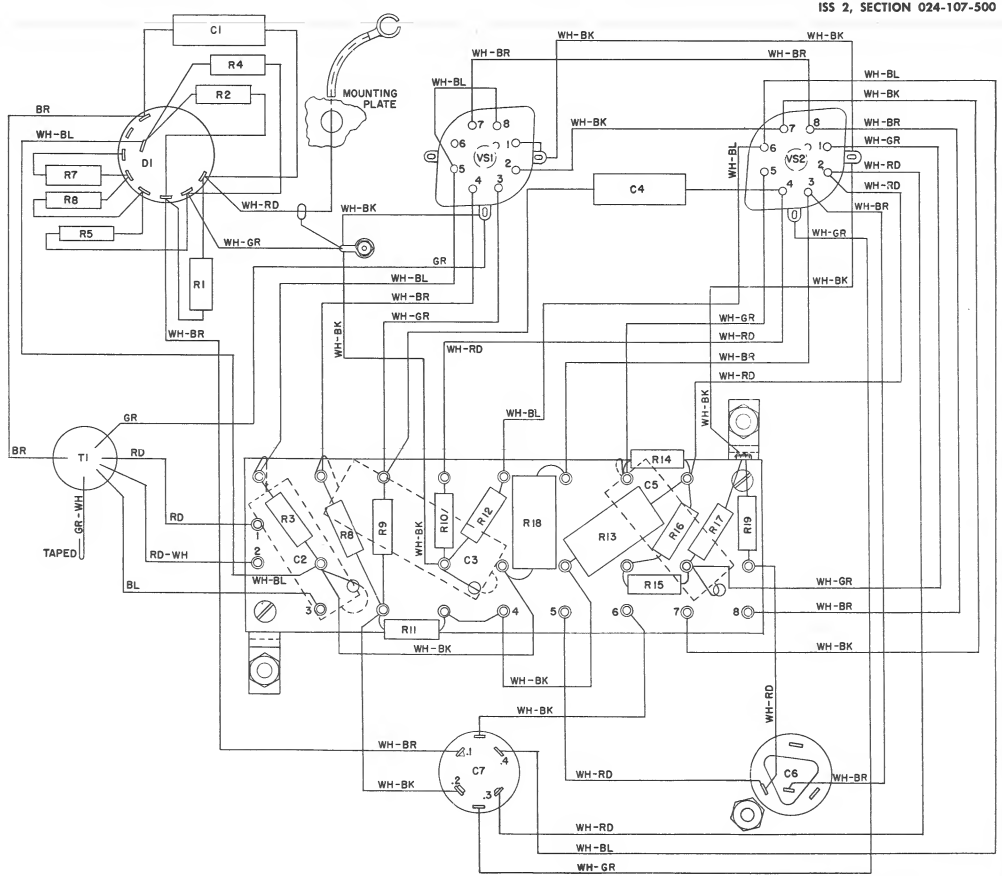


Fig. 12 — 143B Input Circuit Arrangement (141A Amplifier Wiring Diagram)